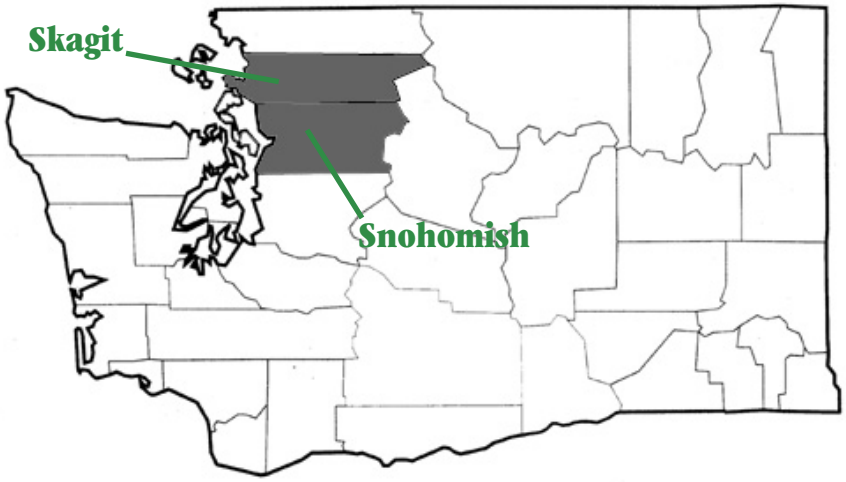
# Crop Profile for
# Spinach Seed
# in Washington

## Production Facts (12)

- Washington State produces up to 75% of U.S. spinach seed, which accounts for 8-10% of world production.
- 2000-3000 acres of spinach is grown for seed annually in Washington.
- Annual value of market seed sold to commercial growers is $24 million.
- Grower production costs average $1000-1200 per acre per year.

## Production Regions

Major spinach seed-producing areas are Skagit and Snohomish Counties in northwest Washington.



## General Information

***Gravity separator.***

There is no open market (non-contracted) small-seeded vegetable seed production in Washington. Commercial vegetable seed production is under bailment contracts, where the seed companies (bailors) provide growers (bailees) with the seed necessary to produce a crop. The seed company retains ownership of the seed, growing crop, and resulting harvested seed. Growers produce and harvest the crop and are then paid the contract price for the resulting seed if it meets quality criteria stated in bailment contracts, typically an 87.5 to 90% germination rate and 99 to 99.85% purity. Weed seeds that are the same or nearly the same size/shape as the vegetable seed are difficult to remove at the conditioning plant and can cause seed companies to reject a seed crop. Federal regulations for moving seed into interstate commerce require that seed must be completely free of all noxious weeds.

Small-seeded vegetable seed production takes place on approximately 6,000 acres in western Washington, contracted by seven seed companies. The average field size for spinach seed production is 20 to 30 acres. Fields are scheduled for long (6-15 year) rotation periods depending upon whether inbred parent lines used in production have Fusarium wilt tolerance. Companies control the location of seed crop fields in order to prevent cross-pollination of different varieties of the same crops (i.e., open-pollinated spinach seed vs. hybrid spinach seed) and of cross-compatible crops (e.g., beet and Swiss chard). Isolation distances vary depending on whether crops are wind- or insect-pollinated and whether they are grown for market or stock seed; distances can range from one-quarter mile to 3 miles or more. Market seed is produced and used for vegetable production. Stock seed is grown specifically for use in planting seed crops.

***Spinach seed.***

Company representatives meet with county agents at the Washington State University Northwest Research and Extension Center (WSU-NWREC) in Mount Vernon each spring in a "pinning" meeting to plot map locations of seed crops planned for that year. With the increased urbanization of the Skagit Valley, and the presence of hobby farmers, it is more difficult to control pollen flow and ensure the isolation necessary for hybrid seed production.

In Washington State, small-seeded vegetable seed crops are considered non-food and non-feed sites for pesticide use.


***Seed conditioning area with clean seed bins.***

## Cultural Practices

Spinach (*Spinacia oleracea*) seed crops are annual, wind-pollinated crops and are direct-seeded between late March and mid-May. Only 10% of the spinach seed crop grown in Washington is open-pollinated; the remaining acreage is hybrid seed. In hybrid seed crops, fields are rogued prior to and during the bloom period to remove male plants and plants not displaying true varietal characteristics. Spinach seed is harvested in July and August. At harvest, the crop is cut and dried in the field for 10 to 14 days. During this period the crop may require hand turning, as seeds shatter easily, to facilitate drying. After the seed is threshed, it is sent to a conditioning plant, where it is cleaned to 99% purity. Spinach is the most economically important small-seeded vegetable seed crop grown in western Washington.

***Temporary seed storage area.***

Any damage to seeds that affects yield, germination rate, purity of type (weed contaminants), or purity from disease will cost the grower money and/or affect his/her ability to do future business with seed companies.

A timeline for the production of spinach seed follows.

# Activity Timeline for Spinach Seed Production

| Month | Week | Field Cultivation | Planting | Hand Roguing | Pesticide Applications | | | Harvest | Irrigation* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Herbicides | Insecticides | Fungicides | | |
| March | 1 | | | | | | | | |
| | 2 | | | | | | | | |
| | 3 | | | | | | | | |
| | 4 | X | X | | X | X | | | |
| April | 1 | X | X | | X | X | | | |
| | 2 | X | X | | X | X | | | |
| | 3 | X | X | | X | X | | | |
| | 4 | X | X | | X | X | | | |
| May | 1 | X | X | | X | X | | | |
| | 2 | X | X | | X | X | | | |
| | 3 | X | | X | X | | | | |
| | 4 | X | | X | | | | | |
| June | 1 | | | X | | | | | |
| | 2 | | | X | | | | | |
| | 3 | | | X | | | | | |
| | 4 | | | X | | | | | X |
| July | 1 | | | X | | | X | | X |
| | 2 | | | | | | X | | X |
| | 3 | | | | | X | X | | |
| | 4 | | | | | X | X | X | |
| August | 1 | | | | | | | X | |
| | 2 | | | | | | | X | |
| | 3 | | | | | | | X | |
| | 4 | | | | | | | X | |
| September | 1 | | | | | | | X | |
| | 2 | | | | | | | X | |
| | 3 | | | | | | | | |
| | 4 | | | | | | | | |

* Irrigation is via big gun sprinklers. The use of irrigation varies from year to year depending upon the weather and also varies from grower to grower depending upon water availability.

***Seed storage/dryer bins.***

## Weeds

Weeds are considered the most important pests in spinach seed production. Two factors are primarily responsible for this. The first is that spinach is not competitive against weeds during its early growth, and the second is that spinach is sensitive to most herbicides. Spinach is closely related to the weed lambsquarters, which is used as a target weed in herbicide screening trials to identify useful herbicides for spinach seed production.

Weed competition can reduce the yield in seed crops. Competition from weeds can result in 100% yield loss if weeds are not controlled. Weeds present at harvest interfere with threshing, reduce harvest efficiency, and increase mechanical damage to the seed. Many weed species can also serve as hosts for diseases and insects that affect crop plants. Weed seeds can also be contaminants of harvested spinach seed. This can either affect marketability of the seed, or result in higher cost to the grower if several conditioning runs must be made to decrease the contamination to acceptable contract levels.

Typical weeds affecting spinach grown for seed include annual grasses (e.g., annual bluegrass, *Poa annua*), seedling perennial grasses (e.g., quackgrass, *Elytrigia repens*, and perennial ryegrass, *Lolium perenne*), pale ladysthumb (*Polygonum lapathifolium)*, catch leaf bedstraw (*Galium aparine*), pale smartweed (*Polygonum lapathifolium*), corn spurry (*Spergula arvensis*), shepherdspurse (*Capsella bursa-pastoris*), common groundsel (*Senecio vulgaris*), chickweed (*Stellaria media*), pigweed (*Amaranthus* spp.), henbit (*Lamium amplexicaule*), pineapple-weed (*Matricaria matricariodes*), nightshade (*Solanum* spp.), wild buckwheat (*Polygonum convolvulus*), mustard (*Brassica* spp.), lambsquarters (*Chenopodium* spp.), and volunteer grains such as barley (*Hordeum vulgare),* and wheat (*Triticum aestivum*).

### *Cultural Controls*

Crop rotation and mechanical cultivation are practiced by 100% of Washington State spinach seed growers. Weather factors in western Washington do not permit delayed seeding dates. Growers hand hoe in the female rows of hybrid spinach seed crops several times during the season.

### *Chemical Controls*

**Phenmedipham (Spin-Aid at 0.5 to 1.0 lbs. AI/A)** is applied when plants have developed 4 to 6 true leaves. Temporary crop damage may occur. It is applied to 95% of spinach seed crops to control lambsquarters, mustard, pigweed, chickweed, smartweed, shepherdspurse, wild buckwheat, and nightshade. This is a critical use herbicide as it is the only postemergence herbicide available to the industry.

**Cycloate (Ro-Neet 6E at 2 lbs. AI/A)** (SLN WA-020003A and C) is applied at planting to approximately 50% of the acreage planted to spinach seed, to control hairy nightshade, henbit, pigweed, shepherdspurse, annual grasses, lambsquarters, and volunteer barley. The SLN makes it available for use only by members of the Puget Sound Seed Growers Association. This herbicide is a critical use to the industry.

**Ethofumesate (Nortron SC at 0.75 lbs. - 1 lbs. AI/A)** (SLN WA-010001) is applied at planting to 10% of the acreage planted to spinach seed to control lambsquarters, pigweed, smartweed, nightshade, annual grasses, shepherdspurse, and volunteer grains. Crop damage may occur.

**Fluazifop-P-butyl (Fusilade DX at 0.19 - 0.25 lbs. AI/A)** (SLN WA-040006) is applied to 5% of spinach seed crops from seedling to fresh market stage to control annual grasses and seedling perennial grasses. (Note: the term fresh market stage refers to a growth stage of

the crop; spinach seed crops are not grown as "fresh market" spinach.)

**S-Metolachlor (Dual Magnum at 0.32 to 0.64 lbs. AI/A)** (SLN WA-030039) is applied to 50% of the spinach seed acreage. It is applied at planting in an 8- to 10-inch band over the row. Some stunting of plants may occur if heavy rain falls after application, but spinach plants will recover. With the loss of chlorpropham (Furloe), this is the only alternative for the control of weeds such as pale ladysthumb and pigweed that are not controlled by the use of cycloate. Therefore, this is a critical use pesticide.

**Diquat (Reglone at 0.5 lbs. AI/A)** (SLN WA-040011) is applied at 1.5 to 2.0 pt/A three to ten days before harvest. Plants stop growing and cure better with application of a desiccant. Weeds that make harvest difficult are also killed with this treatment, resulting in a more uniform harvest. Wet weather in the fall in western Washington necessitates quick drying times for seed crops. This is the only desiccant available, thus is a critical use to the industry. Diquat is used on 2% of the spinach seed acreage annually.

## Diseases

Diseases are the second most important pests of spinach seed. These pests drive the long (8- to 10-year) rotation periods used to prevent disease buildup. These rotation periods are necessary even when using resistant plant varieties.

### Fusarium Wilt

*(Fusarium oxysporum f. sp. spinaciae)*

Fusarium wilt is a fungal disease that causes wilting and death of spinach plants at any stage of growth. It is the most serious disease of spinach seed crops. Infected older plants exhibit chlorotic older leaves, early maturity, low seed production, and premature death. The pathogen can persist for many years in the soil in the absence of a host crop and can also survive on seed, causing disease in fields previously free of spinach wilt. Table and fodder beets, Swiss chard, and *Lychnis* species (campion) are also susceptible to this pathogen. The disease is favored by warm, acidic soils. It can devastate a planting and result in 100% crop loss if not controlled in a field with a high inoculum level of the pathogen.

#### *Cultural Control*

Growers carefully select planting sites where Fusarium wilt has not been a problem. Crop rotation is practiced on a 6- to 12-year or longer rotation cycle for parent lines with Fusarium wilt tolerance, and a 12- to 15-year rotation cycle for parent lines with no Fusarium wilt tolerance. Rotations include peas, cereals, and processing vegetables. Tolerant or resistant varieties are planted but spinach growers have very limited (or no) options for selection of parent lines when producing seed of specific cultivars. Early planting may allow seedlings to develop prior to soil temperatures becoming conducive for the pathogen.

### *Chemical Control*

Benomyl (Benlate) was the standard industry seed treatment for controlling early stages of Fusarium wilt, but loss of all agricultural uses of this fungicide in the United States has resulted in a critical need to identify alternative effective fungicide seed treatments.

## Downy Mildew

(*Peronospora farinosa* f. sp. *spinaciae*)

Downy mildew and leaf spot complex are tied for the second most important disease in spinach seed production. Downy mildew is caused by an Oomycete (water mold) that causes leaf damage and can create open wounds which the leaf spot fungi may penetrate. Plant stunting and death may occur in severely infected plants. Infection is systemic and the pathogen can be mixed with the seed as oospores or as mycelium in the seed. The pathogen overwinters in plant debris and volunteer spinach plants. Oospores produced in diseased plants may be plowed under in the field and survive in soil for up to one year. Oospores mixed with the seed may survive for up to two years. This disease has the potential to cause a yield loss of 20% if not controlled.

### *Cultural Control*

Crop rotation out of spinach for several years is practiced to reduce disease inoculum. Volunteer spinach is controlled in adjacent fields. Infected seed can be hot water treated at 122°F for 25 minutes.

### *Chemical Control*

**Cymoxanil (Curzate 60 DF at 3.2 oz of product/A)** (SLN WA-990021) must be used in combination with another registered protectant fungicide. Applications begin when conditions indicate downy mildew infection is imminent. Additional applications can be made at 5- to 7-day intervals for a maximum of 5 applications per 12-month period. Used on 10 to 20% of the spinach seed acreage.

**Mefenoxam (Ridomil Gold EC at 0.5 to 1.0 lbs. AI/A)** is applied once as a preplant incorporation or surface application at planting at 1 to 2 pints/acre in sufficient water or liquid fertilizer to cover the row. This fungicide is not applied to foliage to minimize the potential for development of resistant fungi. Approximately 10% of the spinach seed acreage is treated annually.

**Chlorothalonil (Bravo Weatherstik at 2.25 lbs. AI/A)** (SLN WA-950036B) is applied preventively from bolting to early bloom when conditions favor disease. Usually more than one application is made at a rate of 3 pints/acre on a 7- to 14-day schedule. Chlorothalonil is used to treat 35% of the spinach seed acreage. The applications also provide some control of Cladosporium and Stemphylium leaf spots.

**Copper hydroxide (Kocide DF at 1.84 lbs. AI/A)** is first applied at early bloom or at the first appearance of disease. The recommended rate is 2-3 lbs. product/acre. More applications may be made at 7- to 10-day intervals when conditions are favorable for disease. Copper fungicides are applied to approximately 20% of the spinach crop grown for seed production. Copper products are not as effective in controlling downy mildew as other fungicides. Leaf burning can occur under western Washington conditions.

**Copper oxychloride and basic copper sulfate (C-O-C-S WDG at 0.89 - 2.67 lbs. AI/A)** is usually applied more than once, at 7- to 10-day intervals, at a rate of 1-3 lbs. product/acre, when conditions are favorable for disease. Copper products may cause leaf flecking under certain environmental conditions. Copper fungicides are applied to approximately 20% of the spinach crop grown for seed production. Copper products are not as effective in control-

ling downy mildew as other fungicides. Leaf burning may occur under western Washington conditions.

**Fosetyl-aluminum (Aliette WDG at 2-5 lbs. product/A)** is applied on roughly 3 to 5% of spinach seed acreage in at least 10 gal water/A. It is not applied within a few days of any copper applications. It is applied when visible symptoms of downy mildew are present, usually late in season (when the crop is bolting) when there is wet weather and a full crop canopy.

**Azoxystrobin (Amistar or Quadris at 0.20 to 0.25 lbs. AI/A)** is applied on 50 to 70% of the acreage. Applied at first pollen shed as a protectant, then applied on a 5- to 7-day interval when conditions are conducive. Growers alternate applications with fungicides with different modes of action.

## Leaf Spot Complex

(*Cladosporium variabile*, *Stemphylium botryosum*, and others)

Tied with downy mildew for the second most serious disease in spinach seed production, this disease is associated with a complex of several fungi of which *Cladosporium variabile* and *Stemphylium botryosum are* believed to be the primary pathogens. Foliar damage from downy mildew infections can create sites for leaf spot infection. The disease causes spotting and death primarily of older leaves, but in severe cases can kill all leaves and infect seed. Infected volunteer spinach can serve as a source of inoculum of *C. variabile*, and infested spinach stem debris remaining on the soil surface after harvest serves as a source of inoculum of *Pleospora herbarum*, the sexual stage of *S. botryosum*. *P. herbarum* forcefully discharges spores into the air the following spring, which may serve as a source of inoculum for newly-planted spinach seed crops. Both leaf spot fungi can be seedborne and seed-transmitted. *C. variabile* has a lower optimum temperature range than *S. botryosum*. In addition, leaf spot caused by *S. botryosum* is more severe in the presence of spinach pollen, so protective fungicide applications for leaf spot are initiated just prior to the start of pollen shed and continued at appropriate intervals (7 to 14 days) when conditions remain conducive (extended moist periods). If not controlled, this disease can result in a 50% loss of the spinach seed crop and high levels of infection of the harvested seed.

Dr. Lindsey du Toit, WSU Vegetable Seed Pathologist, is investigating the potential for use of sodium hypochlorite as a seed treatment for control of seedborne *C. variabile*, *S. botryosum*, and *V. dahliae*. A request for a Special Local Needs registration may be pursued, depending upon on the results.

### *Cultural Control*

Tolerant or resistant varieties can be grown, but seed growers have very limited options for selection of parent lines when growing seed for particular spinach cultivars. Therefore volunteer spinach and spinach debris are incorporated into the soil in the fall to prevent *C. variabile* and *S. botryosum*, respectively, from overwintering to the next season. The sexual stage of *S. botryosum* does not develop on buried spinach debris, so fall incorporation of residues by all growers is important for regional management of leaf spot. Hot water (122 ºF for 20-30 minutes) seed treatment may eradicate *C. variabile* from seed, but is less effective against seedborne *S. botryosum*.

### *Chemical Control*

**Chlorothalonil (Bravo Weatherstik at 2.25 lbs. AI/A)** (SLN WA-950036A and B) is applied preventatively at early bloom, but are only needed when conditions favor leaf spot. Usually more than one application is made at a rate of 3 pints/acre on a 7- to 14-day schedule. Twenty percent of the spinach seed acreage is

treated with chlorothalonil. The applications are also effective in controlling downy mildew.

**Mancozeb (Manzate 75DF and Dithane DF Rainshield at 2 lbs. product/A)** (SLNs WA-010018 and WA020028) is applied late in season usually after male row removal (two to three weeks before harvest). Used in combination with azoxystrobin or chlorothalonil. Used on 10 to 15% of acreage. Newer generation chemicals are replacing early application of this chemical. Preventative applications are made at early bloom if conditions favor leaf spot. If conditions remain conducive for leaf spot, applications may be repeated on a 7- to 14-day interval.

**Azoxystrobin (Amistar or Quadris at 0.20 to 0.25 lbs. AI/A)** is more effective at controlling leaf spot than mancozeb or chlorothalonil. Growers initiate applications just prior to the onset of pollen shed, as leaf spot is exacerbated by the presence of spinach pollen. Growers alternate or tank mix applications with fungicides with different modes of action to avoid fungicide resistance in the pathogen populations. Applications are only needed when conditions are conducive (extended periods of leaf wetness), and can be repeated at 7- to 14-day intervals. Used on approximately 20% of spinach seed acreage.

**Pyraclostrobin (Cabrio at 12-14 oz per acre)** is used on 80 to 90% of spinach acreage. Applied one to three times per season. Usually the first application is made at pollen shed followed by rotation with Quadris 14 to 21 days later. Late application is very effective in controlling leaf spot.

## Damping-Off

(*Pythium* spp. and *Rhizoctonia solani)*

*Pythium* spp. and *Rhizoctonia solani* are soilborne fungi that attack germinating spinach seedlings as well as many other plant species. They can survive in soil indefinitely. Infection can occur prior to seedling emergence, thereby preventing emergence, or young plants can be attacked during emergence resulting in plant loss. Cool weather, high humidity, and saturated or compacted soils favor development of damping-off. Under favorable conditions such as a wet spring, seedling death may reach 100% if non-treated seed is planted in soils where these fungi are established.

### *Cultural Controls*

Sites are selected with good drainage to promote rapid, vigorous seedling growth. Plants are spaced to aid airflow throughout the subsequent canopy. Scrupulous sanitation, including removal or decomposition of plant debris, is practiced along with crop rotation with cereals to reduce inoculum levels.

### *Chemical Controls*

**Metalaxyl (Apron XL LS at 0.32 to 0.64 oz product/100 lbs. of seed)** seed treatment is used on all of the spinach seed planted for seed production. This fungicide is effective in controlling *Pythium* spp., but does not control damping-off caused by *R. solani*.

**Mefenoxam (Ridomil Gold EC at 0.5 lbs. AI/A)** is applied once as a preplant incorporated treatment or as a surface application at planting. The application rate is 1 to 2 pints/A in sufficient water or liquid fertilizer to cover. This fungicide is not applied as a foliar treatment to minimize the potential for development of resistant fungi. Approximately 10% of the spinach seed acreage is treated annually.

## Verticillium Wilt

(*Verticillium dahliae)*

Recent research has revealed the prevalence of *V. dahliae* in spinach seed produced in the United States and the European Union, and seed companies face restrictions for some export markets if seed lots are infected with this fungus. Verticillium wilt appears to be an emerging disease of concern to spinach seed

growers in Washington. This may be due, in part, to the increase in acreage of rotation crops susceptible to Verticillium wilt (e.g., potatoes) and reduction in acreage of rotation crops resistant or immune to Verticillium wilt (e.g., peas). *V. dahliae* is seedborne, seed-transmitted, and highly systemic in spinach, readily infecting the harvested seed. However, symptoms of Verticillium wilt usually are not expressed until after initiation of bolting (reproductive growth) in the crop, and can readily be misdiagnosed as premature senescence or late-season Fusarium wilt. Symptoms include interveinal chlorosis of the lower leaves, followed by wilting and necrosis progressing up the plant. Susceptible varieties may be killed by Verticillium wilt under conducive conditions (warm and dry). The fungus persists for many years in the soil and has a relatively broad host range, although research is needed to verify the specific vegetative groups of *V. dahliae* pathogenic to spinach compared with other rotation crops.

Dr. Lindsey du Toit, WSU Vegetable Seed Pathologist, is investigating the potential for use of sodium hypochlorite as a seed treatment for control of seedborne *C. variabile*, *S. botryosum*, and *V. dahliae*. A request for a Special Local Needs registration may be pursued, depending upon the results.

### *Cultural Control*

Growers control volunteer spinach and practice long crop rotations that include non-host crops (e.g., monocotyledonous crops such as cereals and ornamental bulbs, or broccoli). Hot water (122ºF for 20-30 minutes) seed treatment can significantly reduce the amount of inoculum in spinach seed.

### *Chemical Control*

No fungicides are available or registered that have efficacy against Verticillium wilt, either as seed treatments or as foliar applications.

## Insects

Insect pests do not damage the seed directly, but affect seed quality and yield through damage to the plant during early growth. The importance of various insect pests varies from year to year. Unlike information in the other pest sections, the information here is presented in alphabetical order

### Aphids

(several species including bean aphid, *Aphis fabae*, green peach aphid, *Myzus persicae*, and melon aphid, *Aphis gossypii*)

Aphids feed on the foliage of plants, causing leaf decline or overall plant decline. Aphids may also serve as vectors for viral diseases such as cucumber mosaic virus. These aphid species are black, yellowish-pink to pale green, and yellowish to dull green, respectively. Potential yield loss to growers is 30% if aphids are not controlled.

### *Chemical Control*

**Pymetrozine (Fulfill at 2.75 oz product/A)** (SLN WA-000017) is used on 60% of the spinach seed acreage. It is applied after male row removal (typically 2 to 3 weeks before cutting). The maximum allowable application is 5.5 oz product/A/season with a minimum of 7 days between applications.

### Cutworms, Armyworms, and Loopers

(several species including alfalfa looper, *Autographa californica*)

Cutworms and loopers are variously colored and patterned moth larvae. They feed primarily on leaves, although cutworms may also completely sever stems of young plants. Several species cause similar damage and are controlled in the same manner. Seed may also be damaged. Potential yield loss to growers is 30% if cutworms and loopers are not controlled.

### *Chemical Controls*

**Dimethoate or Permethrin (Dimethoate 4 EC at 0.25 lbs. AI/A or Ambush at 0.1 to 0.2 lbs. AI/A)** are applied at labeled rates after male rows have been removed, 2 to 3 weeks before cutting. In a given year, between 30 and 50% of the spinach seed acreage is treated for cutworms, armyworms, or loopers, depending upon insect pressure.

## European Cranefly

(*Tipula paludosa*)

The gray-brown, wormlike larvae of cranefly are known as leatherjackets. They feed underground on roots and stems of clover and a number of vegetables and are particularly damaging to seedling vegetables. They are a sporadic but potentially serious pest, particularly in fields planted to vegetable seed immediately after a pasture rotation. Potential yield loss to growers is 100% in affected areas if craneflies are not controlled.

### *Chemical Controls*

**Carbofuran (Furadan 15G at 6.7 oz product/1000 linear ft. row)** (SLN WA-860012) is used on 75% of the spinach seed acreage at planting. This product also controls springtails.

## Springtail

(mainly *Onychuirus pseudarmatus*)

Springtails are small, white, slow-moving, soil-dwelling insects that feed on germinating seeds or on seedling roots. Infestations are primarily localized or occur in irregular spots in fields. Damage causes reduced stands and loss of vigor in surviving plants. Although this pest is sporadic, potential yield loss to affected growers is 100% if springtails are not controlled.

### *Chemical Controls*

**Carbofuran (Furadan 15G at 6.7 oz product/1000 linear ft. row)** (SLN WA-860012) is used on 75% of the spinach seed crop acreage. Treatment takes place at planting as a seed furrow treatment (maximum of 13 pounds per acre). Furadan 15G also controls European cranefly. In tests by WSU researchers, no other insecticide has been found effective against springtails.

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**Use pesticides with care.** Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.



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